

element with exosmosis. Curves representing the equation derived thus on theoretical grounds resemble in type those obtained in actual experiments. The methods used in this work seem admirably adapted to a crucial test of CZAPEK's theory, which seems entirely untenable in view of the evidence submitted.—CHARLES A. SHULL.

Desiccation.—An investigation of the course of desiccation and partial starvation in cacti has been made by MACDOUGAL, LONG, and BROWN.¹⁵ The principal studies center upon the changing rate of water loss, chemical changes in the food reserves, plasmatic colloids, and cell sap, and the morphological changes which occur during long periods of desiccation. In one case a large *Echinocactus* was under observation for 6 years after removal of the plant from the soil. Water loss is rather rapid at first, but proceeds more and more slowly with time. While 10 per cent of the water was lost the first year in one specimen, during the sixth year only 5 per cent of the water remaining at the beginning of that year was lost. The loss of water is much more rapid of course in the open than in diffuse light and *Echinocactus* can withstand desiccation not more than 2 years with free exposure.

The chief chemical changes noted during the starving period concern the carbohydrates. The density of the cell sap decreases, due to disintegration of the carbohydrates, and the reducing sugars are found mainly in the inner part of the cortex in desiccated specimens rather than near the surface as in normal plants. The total amount of reducing sugars decreases during desiccation, while non-reducing sugars are increased noticeably in the cell sap. Reduction of the amount of sugars leads to reduction of acidity if the light intensity is sufficient for photolysis of the acid. In weak light even, if the sugars run low, the acids may accumulate because of the absence of photolysis. Differences in acidity are thought to be partially responsible for differences in the colloid hydration and swelling of tissues when placed in water.

The main morphological changes consist in thickening of the cuticle, thinning of the anterior walls of the guard cells, partial destruction of the plasmatic colloids, shrinkage in the size of the nucleus, and especially the development of cortical lacunae through hydrolysis of the cell walls of this region of the stem. The vascular tissues are not affected, and the medullary cells much less than the cortical cells.—CHARLES A. SHULL.

The vegetation of Michigan.—From the data obtained during a few weeks in Michigan, HARPER¹⁶ has listed the principal plants in the order of their abundance and has discussed certain features of the environment. He recognizes but two types of succession, the one from the filling up of lakes and other

¹⁵ MACDOUGAL, D. T., LONG, E. R., and BROWN, J. G., End results of desiccation and respiration in succulent plants. *Physiol. Res.* 1:289-325. 1915.

¹⁶ HARPER, R. M., The plant population of northern lower Michigan and its environment. *Bull. Torr. Bot. Club* 45:23-42. 1918.